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**Dr. Theodore Thomson's Report to the Local Government
Board on an outbreak of Enteric Fever in the Urban
District of Bicester.**

R. THORNE THORNE,
Medical Officer,
August 6th, 1896.

IN the early part of February last the attention of the Board was directed to the fact that the Registrar-General's Returns for the quarter ended December 31st, 1895, indicated that there had been during that quarter seven deaths from "fever" in the Bicester Registration Sub-District with a population of 7,513. Their attention was also further directed to this fever prevalence by a letter, dated February 18th, and signed by certain householders in the Bicester Urban District, in which it was stated that there had been 57 cases of enteric fever in Bicester since August 11th, 1895, and that fresh cases were still occurring. The persons signing this letter further requested that the Board should make inquiry into this outbreak. No information had been received by the Board from the Medical Officer of Health of the Bicester Urban District as to fever occurrence there. I was accordingly, on March 16th, instructed by the Board to make inquiry into the circumstances attendant on the enteric fever outbreak in question; and, in accordance with these instructions, I visited Bicester on March 27th, and made inquiry in the sense indicated both then and on subsequent occasions.

The outbreak of fever had, I found, been limited to that part of the Bicester Registration Sub-District included in the Bicester Urban District, which, on an area of 3,740 acres, had, at the census of 1891, a population of 3,343 persons occupying 702 houses. The population of the district is nearly stationary, the census of 1891 having shown an excess of only 37 over the enumerated population in 1881. By far the larger part of the inhabitants of the Bicester Urban District reside in the town of Bicester, which has a population of about 3,000 persons.

The town of Bicester, 12 miles from Oxford, is the market town for a considerable agricultural district. It stands upon the clays and calcareous sandstones of the Cornbrash, overlying the argillaceous limestone of the Forest Marble, which crops out on the surface in the immediate neighbourhood of the town. The houses of Bicester are for the most part grouped along two main streets, which diverge from the market place in such fashion that the town may be said roughly to form a V, of which the market place

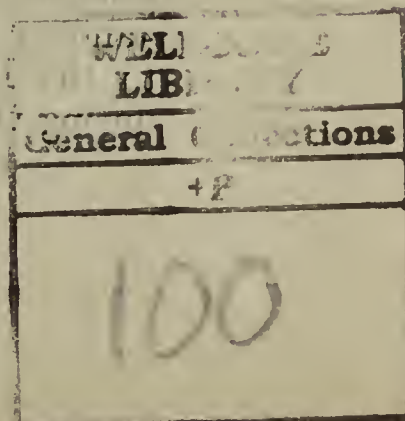
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is the apex. The roadways of the main streets are constructed of macadam with footways of flagstones or of cement, and are fairly good save in so far as they are unprovided with channelling of stone or of other suitable material. The condition of bye-streets, however, frequently leaves much to be desired. A considerable number of dwellings are old; and of these old dwellings not a few are dilapidated and damp, while many are unsatisfactory as regards light and ventilation. Open space in the neighbourhood of inhabited houses is usually sufficient; but in some instances dwellings are closely huddled together and furnished with yards of very scanty dimensions. The surface of some of these yards, which are paved, is broken and uneven; other yards are entirely unpaved. House and yard drainage is for the most part effected by means of 4-inch or 6-inch sanitary pipes, rarely disconnected properly from the sewers to which they discharge. House and yard drains not infrequently pass beneath dwellings; and those portions of the drains are but rarely embedded in concrete. Yard drains are in not a few instances untrapped, or are fitted with traps of inefficient sort. Indoor sinks are unusual in houses of the poorer class, but are, where they exist, usually disconnected from the drains to which they discharge. Excreta are disposed of mostly in vault privies or in pail closets; there are only a few waterclosets, usually of the long-hopper pattern and devoid of flushing apparatus. House refuse is stored in pails and tubs, and is, along with the contents of pail closets, removed twice a week by the District Council. Removal of the contents of vault privies devolves upon the owners or occupiers of the houses to which they are attached, and these receptacles are seldom cleansed oftener than once a year. The sewerage system of the town is formed for the most part by 9-inch and 12-inch sanitary pipes converging to an 18-inch brick barrel sewer, by which the sewage is conveyed to outfall works. These works are about a mile south of the town and consist of six settling tanks, from which the sewage is distributed by carriers over pasture land in the vicinity. The effluent sewage from this land finds its way into a neighbouring brook. The majority of the sewers in Bicester are said to have been laid down some 35 years ago, but there are one or two short lengths of sewer of more recent construction. There is reason to believe that some sewers are in a defective condition. Provision for ventilation of sewers is either inadequate or entirely absent. Save in the case of two short lengths of sewer of more recent construction, sewers are entirely devoid of manholes or lamp-holes. Flushing of sewers, when attempted, is sought to be effected by emptying the contents of water carts down street gulleys. The water supply of Bicester is furnished in the main by shallow wells, usually dry-steined, sunk in the rubbly rock on which the town stands; partly by two springs at the northern end of the town, known as the Crockwell spring and the Brockless spring respectively, and by the Bicester brook, which flows through the town and from which a few households take their domestic water supply.

The history of Bicester as regards prevalence of enteric fever in the past cannot be regarded as satisfactory. During the 10 years, 1885–1894, 8 deaths were referred to enteric fever in the urban district, affording a mean annual death-rate from this cause of 0·24 per thousand during the period quoted. In four only out of those 10 years was no death referred to this cause in Bicester. During this same period the mean death-rate from enteric fever per 1,000 persons living in England and Wales was 0·18. Notification of enteric fever, among other diseases, became compulsory in the Bicester Urban District in 1890; and during the five years 1890–94, 66 cases of this disease were notified to the Sanitary Authority as having occurred in this district. Fifty-six of these were notified in 1890 alone; and to this occurrence of fever reference will again be made at a later stage of this report.

The time of commencement and the subsequent course of the more recent outbreak of enteric fever which forms the subject of this report will be gathered from the appended table, which shows, month by month, from January 1895 to March 1896, the number of cases of enteric fever notified to the Bicester Urban District Council as having occurred in their district during this period. The table also gives the number of deaths referred to



this cause during the same period, and, in addition, takes note of a few cases of sickness which, though not notified to the District Council by the medical attendants, were by these latter, nevertheless, regarded as bearing a suspicious resemblance to enteric fever.

TABLE showing, Month by Month, during 1895, and the First Quarter of 1896, the NUMBER of PERSONS reported to the BICESTER URBAN DISTRICT COUNCIL as attacked by ENTERIC FEVER in their District; also the NUMBER of PERSONS known to have suffered from Disease suspected to have been Enteric Fever, and the NUMBER of DEATHS referred to Enteric Fever in this District during the same Period.

Period.					Number of Persons notified as attacked by Enteric Fever.	Number of Persons attacked by Disease suspected to have been Enteric Fever.	Number of Deaths referred to Enteric Fever.
January 1895	-	-	-	-	—	—	—
February „	-	-	-	-	—	—	—
March „	-	-	-	-	—	—	—
April „	-	-	-	-	—	—	—
May „	-	-	-	-	1	—	—
June „	-	-	-	-	—	—	1
July „	-	-	-	-	1	—	—
August „	-	-	-	-	1	—	—
September „	-	-	-	-	—	5	—
October „	-	-	-	-	20	3	—
November „	-	-	-	-	13	3	6
December „	-	-	-	-	14	—	1
January 1896	-	-	-	-	5	—	2
February „	-	-	-	-	4	—	1
March „	-	-	-	-	2	1	—
January 1895 to March 1896 -					61	12	11

It will be observed from the above figures that within the period embraced by the table 61 cases of enteric fever were reported as having occurred in the district, while 11 deaths were referred to this cause; and that 12 persons are known to have suffered from illness which, although not reported to the District Council as enteric fever, was in each instance regarded as having been suspiciously like that disease. During the above-mentioned period only three cases of enteric fever were reported before October 1895, in which month the reported cases suddenly rose to 20; remaining numerous during November and December, and decreasing during January, February, and March of 1896. The “suspicious” cases were mostly noticed just before or during the early stages of the outbreak of diagnosed enteric fever. With one exception these suspicious cases occurred in houses that already had been, or that were subsequently notified as, invaded by enteric fever. Altogether 30 houses were reported as invaded by enteric fever during and subsequent to the month of October; these 30 houses having a population of 194 persons of whom 58 were reported as attacked by enteric fever. It will be seen, therefore, that nearly a third of the persons living in these houses were notified as attacked by enteric fever in the course of this outbreak.

In the 12 months, April 1895 to March 1896, the mortality caused by enteric fever in the Bicester Urban District was 3·3 per thousand persons living; and the fatality of the disease during the same period was, if suspicious cases be not reckoned as enteric fever, 18 per cent. of persons attacked. The outbreak therefore was, in regard of the small population involved, a serious one.

This outbreak of enteric fever did not extend over the whole of Bicester; it was, in fact, almost entirely restricted to the northern part of the town, as may be seen by reference to the appended map. With five exceptions all the invaded houses lay tolerably near together towards the extremity of one of the limbs of the V which the town of Bicester forms; and, indeed, of these five exceptions three were houses which, although not situated within the area of chief invasion, were nevertheless at no great distance therefrom. Accordingly, in search for the cause of the outbreak, only possible fever-agencies restricted in their operation to the quarter of the town mainly affected by the disease could be accepted as satisfactorily accounting for its occurrence. In this respect possible causes of fever such as sewerage conditions, general sanitary circumstances, and milk supply were alike found to fail.

As regards sewerage conditions, there did not appear reason to regard them as more faulty in the area chiefly invaded by fever than in other parts of Bicester entirely free from the disease; indeed, the sewers in St. John Street and Field Street, in both of which streets several houses were invaded by the fever, are among the few sewers in Bicester in which attempt at ventilation has been made. Further, the houses in the main area of invasion drain to two sewers passing, as shown on the map, in different directions, and having no connection the one with the other, until they reach the main sewer in Chapel Street, a considerable distance from the area in question.

The general sanitary circumstances of invaded houses were, for the most part, unsatisfactory in one or another respect. Defective drainage arrangements were found in not a few; in some, excreta were disposed of in offensive vault privies; while the houses themselves were not always satisfactory as regards proper access of light and air and freedom from conditions of dilapidation and dampness. Amongst this variety of defective circumstances there were, however, none that could be regarded as accounting for the distribution of the fever; indeed the previously noted localisation of the disease was far from being accompanied by a corresponding limitation of these unhealthy conditions to the part of Bicester in question.

Inquiry as regards milk supply of the 30 invaded houses elicited the information that these had been supplied by one or other of four different vendors. The following list shows the number of invaded houses supplied by each of these four persons, and also the total number of houses ordinarily supplied by them:—

A supplied 21 invaded houses; total houses supplied in Bicester daily							
							about 180
B	„	9	„	;	„	„	„ 80
C	„	7	„	;	„	„	„ 130
D	„	2	„	;	„	„	„ 10

It will be observed that the total number of invaded houses supplied by A, B, C, and D is in excess of 30, this being due to some of these houses taking milk from more than one of these vendors. There was a relatively larger incidence of fever on the customers of A and B than on those of C which may be referred to the fact, ascertained by inquiries made in the chief area of invasion, that A and B supply a relatively greater number of families in the northern or chiefly invaded end of the town. Furthermore, the fact that the disease was almost entirely limited to this end of the town, while all these milk vendors supply other parts of Bicester, is in itself sufficient to exclude milk from suspicion of having been the vehicle by which the fever was disseminated.

When, however, inquiry was made concerning conditions of water supply, a series of facts came to light which were found to be consistent with water having been the agent whereby, in this instance, enteric fever had been spread. Comprehension of these facts will be facilitated by the following list, which shows week by week, during the period of chief prevalence of the

MAP OF BICESTER.

Scale, 25344 inches to one mile.

Houses notified as invaded by Enteric Fever marked ●

Particular Wells & Springs are marked. x

The black lines indicate sewers.



fever, the number of cases notified as enteric fever and also of those suspected to have been enteric fever :—

					Number of Cases notified as Enteric Fever.	Number of Cases suspected to have been Enteric Fever.
During the week ending	September	21st	-	-	—	2
"	"	"	28th	-	—	3
"	"	October	5th	-	—	1
"	"	"	12th	-	—	1
"	"	"	19th	-	—	—
"	"	"	26th	-	10	—
"	"	November	2nd	-	12	1
"	"	"	9th	-	5	3
"	"	"	16th	-	1	—
"	"	"	23rd	-	—	—
"	"	"	30th	-	5	—
"	"	December	7th	-	5	—
"	"	"	14th	-	—	—
"	"	"	21st	-	7	—
"	"	"	28th	-	2	—
"	"	January	4th	-	2	—
September 18th to January 4th					49	11

The first group of cases notified as enteric fever occurred, it will be seen, in the four weeks October 20th—November 16th, and comprised in all 28 persons. Of these 28 persons no fewer than 26 derived their water supply from a spring known as the "Crockwell Spring," shown on the accompanying map. The houses occupied by these 26 persons were all situated in the vicinity of the Crockwell Spring with three exceptions, viz., Bicester House, a house in Rogues Row at the extreme north of the town, and the more easterly of the two invaded houses lying between Sheep Street and Love Alley. All these three houses are provided with wells of their own; but, Crockwell spring having a considerable local reputation, the occupiers of Bicester House and of the house in Rogues Row were in the habit of using the Crockwell Spring water in preference to that of their own wells.* The third of these three houses, namely, the more easterly of the two invaded houses lying between Sheep Street and Love Alley, was occupied at night by two members of the family inhabiting the invaded house in Rogues Row. These two persons slept in the Sheep Street house owing to insufficiency of accommodation at home; but they took their meals at home and, as a consequence, drank of the Crockwell Spring water.

I have noted that 26 of the 28 persons constituting the first group of attacks derived their water supply from the Crockwell spring. Of the two remaining persons one resided in the chief area of invasion. This was a boy nine years of age, residing in a house in Plough Terrace, on the west side of New Buildings, supplied with water from a well common to all the houses in that terrace. The other was a girl residing in the more westerly of the two houses lying between Sheep Street and Love Alley. The house occupied by this girl was in the same yard as that used at night by the two members of the family from Rogues Row, already referred to. These two persons belonging to Rogues Row were both notified as attacked by the fever on October 24th, while the girl was notified as attacked on November 7th, a fortnight later. All three used the same privy.

As regards the 11 cases in the second column considered to bear suspicious resemblance to enteric fever and all attacked prior to November 10th, it appeared, on inquiry, that eight resided in houses which derived their water supply from the Crockwell spring; and three in houses in Plough Terrace supplied from the well common to the houses in that terrace.

The Crockwell spring, it may here be noted, was closed on October 25th, nearly three weeks before the date of notification of the last case of what

* It is noteworthy that this particular house in Rogues Row was the only one in that street known to have been supplied from the Crockwell spring, and was also the only house in that street known to have been invaded by enteric fever.

has been termed the first group of attacks. The disuse of this spring on this date is not, in view of the facts I have given, inconsistent with the water therefrom having acted as the vehicle of infection during the period covered by the first group of cases, if two weeks be allowed for incubation of the disease and one week for sufficient development of symptoms to permit diagnosis. The Plough Terrace well, however, remained in use.

After November 16th a week elapsed without any further notification of fever occurrences to the District Council. But during the fortnight November 24th—December 7th, 10 notifications of persons attacked by enteric fever were received; and of these 10 persons seven resided in houses supplied from the Plough Terrace well, while three derived their supply from other local wells. Of these three persons one resided in the house in Rogues Row before noted as invaded. This person was notified as suffering from enteric fever on November 24th; the last case that had previously occurred in that house having been notified on October 28th, and having been removed to hospital on the same day. The inhabitants of this house had, on the closure of Crockwell spring, reverted to the use of their own well which was dry-steined and within 15 feet of the vault privy used by the household. Another of these three persons was a boy, aged six, residing in New Buildings within the chief area of invasion in a house furnished with water from a well in the yard. The third was an occupant of the remaining one of the five houses formerly noted as lying outside the chief area of invasion, and was a medical man who had been in attendance on the sick both at their homes and at the hospital for infectious diseases to which many were removed.

The well, referred to as Plough Terrace Well, was closed on December 2nd.

After the date of notification of the last case of the second group a week elapsed during which no further cases of fever were notified. But between December 15th and January 4th, 11 more cases were notified as attacked by enteric fever. Of these 11 cases 7 resided in houses deriving their water supply from a well known as Mrs. Woodcock's well (*see map*), one in a house supplied by Plough Terrace well, and three in houses with other supplies. Of the three last-mentioned cases one was a boy of 12, notified on December 15th, residing in New Buildings, in a house where two previous cases had occurred, notified on October 23rd and November 2nd respectively, and which had been treated at home. Another was a girl of 18, notified on December 17th, residing in a house to the east of New Buildings in which a case, notified on November 16th, and a supicious case first attended by a medical man on September 26th, had previously occurred. The third was a second case in the house lying to the west of Sheep Street, outside the area of chief invasion. This case was notified 13 days later than the first already referred to as having occurred in this house; but, on inquiry, it appeared that only nine days had intervened between the dates of *attack* of these two cases.

Mrs. Woodcock's well was closed on January 3rd, 1896.

From January 4th to the end of March 9 cases of enteric fever were notified in Bicester; and one case regarded as bearing supicious resemblance to that disease is known to have occurred. Of the nine notified cases two—notified on January 13th and 17th respectively—occurred in houses supplied with water from Mrs. Woodcock's well, and five—of which the first was notified on January 28th—in houses supplied with water from a spring known as the "Brockless Spring." Of the remaining two one was of a female who had, for some weeks prior to her falling ill, been attending a person suffering from enteric fever; the other was of a resident in New Buildings, occupying a house in which two previous cases had occurred some three months before, and which was supplied with water from a well known as Mrs. Smith's well. The person attacked by illness regarded as resembling enteric fever fell ill about the middle of March. In this patient's house there had already been two cases of enteric fever, notified on October 24th and 31st respectively, and treated at home. Subsequent to the closure of the Crockwell spring the occupants of this house had derived their water supply from Mrs. Smith's well.

It appears from the foregoing account that the fever cases occurred in four successive groups; that persons in the first group used mainly Crockwell spring water; persons in the second group mainly Plough Terrace well water;

persons in the third group mainly water from Mrs. Woodcock's well ; and persons in the fourth group mainly water from the Brockless spring. These facts suggested that the specific contagium of enteric fever had gained access to each of these several springs and wells, and had thus obtained entrance to the bodies of persons making use of water therefrom. Inquiry was accordingly made as to whether the circumstances and surroundings of these sources of water supply had been such as to allow their becoming dangerously polluted.

The *Crockwell Spring*, which was the main source of supply of the first group of persons attacked, is situated, as shown on the map, on the western boundary of the chief area of invasion of the fever, lying at the junction of Field Street and St. John Street. It is completely covered in ; its water rising into the lower extremity of a 30-inch vertical stoneware pipe some 8 feet in length, over the upper end of which is laid a flagstone at the ground level. Water is obtained from it by means of a pump. As will be seen from the map, the sewers in Field Street and St. John Street converge to the neighbourhood of this spring, near which they join, and the joint sewer thus formed passes close to the spring. On the occurrence of the outbreak of fever in October 1895 the greater portion of the Field Street sewer and part of the St. John Street sewer near the spring were exposed, and both of these sewers were then found to be leaking freely into the surrounding soil at several points. The point at which these two sewers join is at a distance of 8 feet from the Crockwell spring, and it was found that this junction had been made by knocking a hole in one of the pipes forming the Field Street sewer and applying to this hole the extremity of one of the pipes forming the St. John Street sewer, while over the partial gap thus left a piece of stone was cemented.* Also it was found that at this point of junction free leakage was going on into the surrounding soil, which is stated to have been quite black. During one of my visits to Bicester, in April 1896, I had this junction again exposed, and found that these conditions remained unaltered. At this date the Field Street sewer close to this point of junction was half full of black silt.

The *Well in Plough Terrace Yard*, which mainly formed the water supply of the second group of cases, is stated to be a shallow dry-steined well. Within 4 feet of it was a urinal (now abolished) attached to a public-house. The floor of this urinal was paved with brick, but I was informed that it had been usual for the adjacent wall and unpaved yard soil to be used for urinal purposes. The drain of the urinal was within 6 feet of the Plough Terrace well, while the drain of the public-house yard was within about 15 feet of this well. Reference to the map will show that the Plough Terrace well lies within and towards the apex of a triangle formed by the Field Street and the New Buildings sewers, from neither of which is it far distant.

Mrs. Woodcock's Well, which mainly supplied the third group of persons attacked, is situated, as shown on the map, behind one of the houses abutting on Field Street. It is shallow and dry-steined, and when attention was directed to it by the occurrence of fever among persons drinking this water it was found that the yard drain, which passed within a few inches of the well, was leaking freely and its contents visibly percolating into the well. This yard drain received water-closet sewage as well as sink and yard drainage.

The *Brockless Spring*, which mainly supplied the fourth group of cases, is an open spring situated to the west of the chief area of invasion, and on the bank of the Bicester Brook. It is surrounded on three sides by gardens which are under cultivation and freely manured, and a vault privy is situated about 45 feet from it. Within some 30 feet of it passes the sewer previously alluded to as formed by the junction of the Field Street and St. John Street sewers. The condition of this sewer in the neighbourhood of the spring is unknown ; but that part of the sewer which lies in the adjacent field where a cesspool is shown on the map was found, when uncovered seven years ago, to contain much silt and to be leaking at many points. The Brockless spring is about $6\frac{1}{2}$ feet below the ground level, and the sewer, at the point where it passes the spring, is said to be about 5 feet below the surface of the ground.

* Both these sewers are constructed of 9-inch sanitary pipes.

It will be seen, therefore, that in the neighbourhood of each of these four springs and wells there were abundant conditions threatening dangerous pollution of the waters in question, and the pervious nature of the soil in which these wells are sunk and through which these springs come to the surface would interpose but little obstacle to the access of polluting matter to them. Samples of water for chemical and microscopic examination were taken from each of these sources of water supply as follows :—

From the Crockwell spring on October 31st, 1895.

„ „ Plough Terrace well on November 27th, 1895.

„ Mrs. Woodcock's well on December 27th, 1895.

„ the Brockless spring on February 22nd, 1896.

Chemical analysis of the sample taken from the Crockwell spring failed to detect anything indicating dangerous pollution of the water; but “a large number of bacteria, whose nature could not be determined by direct microscopic examination,” were discovered in the sample, and this in such amount “as to cast great suspicion on the character of the water.” Chemical examination of the samples of the water from the Plough Terrace well, and from Mrs. Woodcock's well gave unfavourable results in both instances. In the former, the chlorine present amounted to 14·45 grs. per gallon, and in the latter, it was 6·60 grs. per gallon; while in both waters the quantity of albuminoid ammonia was far in excess of that usually associated with pure water. Chemical examination of the sample from the Brockless spring failed to detect anything indicating dangerous pollution of the water.

In view of the foregoing facts I made inquiry as to possible relation between amount of rainfall and outbreak of fever. I was unable to obtain exact meteorological data; but, by the courtesy of Captain Fane of Bicester House, I was furnished with a record of local rainfall, kept by him in such terms as “showers,” “rain,” and “wet,” according to the amount estimated by him to have fallen. From his record it appears that, during the whole month of September 1895, no rain fell in Bicester, save a few “showers” on the 3rd and the 10th* of that month; and that this lengthy period of drought was broken by “wet” weather on the 3rd, 4th, 5th, and 6th of October, closely followed by “rain” on the 8th, 9th, and 10th of the same month.

The first notifications of the outbreak of fever were dated October 22nd, while in the two weeks ending respectively October 26th and November 2nd, no fewer than 22 cases were notified. If two weeks be allowed for incubation of the disease, and about a week for development of symptoms sufficient to permit diagnosis, it will be seen that this rainfall in early October took place about the time when these persons most probably contracted the disease. Owing to there having been a good deal of rain on numerous occasions in November like relationship between rainfall and further outbreaks of fever is not so definitely suggested; but it is noteworthy that the notifications of the second group of cases date from November 24th, and that there was wet weather on November 3rd, 4th, 5th, 7th, 8th, and 9th. As regards the third group of cases, also, it may be observed that while the notifications ranged mostly about the 15th and 20th December, there had been wet weather on the 27th and 28th of November. These facts are consistent with foul matters accumulated in the half-choked and leaky sewers of the northern end of Bicester, and polluting material in the surrounding soil, having been periodically washed by falls of rain into neighbouring wells and springs.

It appears then that of accepted agencies in spread of enteric fever, only one, and that one water, was found parallel in its circumstances with dissemination of fever in Bicester; and moreover that the four water supplies, mainly used by the persons attacked, were all of them open to dangerous pollution. That pollution in this sense had actually occurred was indicated by chemical examination as regards two of these waters, and by microscopical examination as regards a third; while the data given in connection with rainfall tends to suggestion that the degree of this pollution was intensified periodically during wet weather, when foul matters would be likely to be washed into the springs and wells.

Careful inquiry was made as to whether there had been in Bicester anterior to the October outbreak any case or cases of enteric fever to which that

* Possibly connected with the occurrence of “suspicious cases” from September 20th to October 4th.

outbreak might be referable. Three persons are known to have been attacked by enteric fever in the district prior to October, viz., one in May, one in July, and one in August. The cases that occurred in May and August were not within what has been in this report termed the chief area of invasion; the July case was within this area. The last-mentioned case occurred in New Buildings, and was notified on July 25th. But nothing was discovered tending to connect this case or either of the two other cases with the subsequent outbreak. As regards possible pollution of the Crockwell spring, however, by the particulate contagium of enteric fever, it is worthy of note that several common lodging-houses, largely used by tramps, drain into the St. John Street sewer, and that, as before stated, this sewer was found to be in a defective state near the Crockwell spring. No occupant of any of these lodging-houses, so far as could be ascertained, suffered from illness of a suspicious sort during July, August, September, or October 1895.

It is of interest in connection with the epidemic prevalence of enteric fever in Bicester to which this report has reference to recall the fact that, in the latter part of 1890, 56 cases of the same disease are known to have occurred in the district and that then also, as in the recent outbreak, the fever was mainly prevalent in the northern end of the town. Mr. Dyson Wood, then as now Medical Officer of Health for the Bicester Urban District, gave it as his opinion in a report written by him in September 1890 that the outbreak that occurred in that year was principally due to impure water, and he stated that the Crockwell spring which formed the water supply of many of the persons attacked, was found to have "some yards of defectively jointed drain pipes in its immediate neighbourhood."

Action taken by the District Council.

All houses known or suspected to be invaded by enteric fever are stated to have been immediately visited by an officer of the District Council, by whom instruction was given as to the measures of isolation proper to be taken. In many cases where accommodation for isolation at home appeared insufficient, the person attacked was removed to the hospital for infectious diseases jointly provided by the Bicester Urban and Bicester Rural District Councils. In the course of the outbreak 36 persons suffering from enteric fever were removed to this hospital. After removal of the patient to hospital or subsequent to his recovery if treated at home, measures of disinfection were applied to the invaded house. These measures usually consisted of fumigation of the rooms regarded as infected for not less than six hours by sulphurous acid or by vapourised carbolic acid; steeping of infected articles of clothing and bedding, other than mattresses, for 12 hours in a solution of carbolic acid and water of the strength of 1 in 40, and subsequent washing of these articles with carbolic soap and water; exposure of infected mattresses and carpets, after sharing the fumigation of rooms as above, in the open air for as long a period as possible; washing of floors and woodwork of infected apartments with carbolic soap and water, brushing ceilings and walls with a house brush, and, in some instances, whitewashing of ceilings. The sanitary condition of invaded premises was examined, and measures were taken towards correcting sanitary defects discovered. In this way 19 vault privies were abolished and replaced by pail closets; in several instances house drains were taken up and relaid, while in other instances minor improvements in drainage and other conditions were brought about. The Field Street sewer was in large part relaid. The St. John Street sewer, however, although exposed in part of its length, was not repaired, and the defective manner in which junction had been made between the St. John Street and Field Street sewers was allowed to continue. The sewers and several drains in the chief area of invasion were flushed twice a week from December 7th to the end of February, and after February once a week, with a solution of carbolic acid of the strength of 1 in 40. In this way about 10 gallons of carbolic acid were employed each week during the first of these two periods. Inhabitants of houses invaded by fever, as well as of some houses that had not been invaded, were cautioned not to use unboiled water or milk. Samples of water were taken from several springs and wells and submitted to chemical and microscopic examination, and four wells and springs were closed at different dates. Three of these, with the dates of

their closure, have already been referred to : a fourth well in New Buildings was closed on December 12th, 1895.

From the foregoing account of enteric fever in Bicester in 1895 and the early part of 1896, and of the circumstances attendant upon it, it is evident that there are many conditions of unhealthy sort in this district. The most prominent of these is water supply ; and the District Council should, without further delay, furnish the inhabitants of Bicester with a sufficient supply of water of undoubted purity. The Authority have not been without previous warning as to the need for such action. In 1890 Mr. Dyson Wood, Medical Officer of Health to the District, wrote, in his report on the outbreak of enteric fever in Bicester, as follows :—“ In the “ first place, a safe water supply for the district is essential. I am inclined “ to think that no insuperable difficulty need be anticipated under this head.” This constituted one of three recommendations made by Mr. Dyson Wood in that report ; and in reference thereto it was unanimously resolved at a meeting of the Sanitary Authority on September 1st, 1890, “ That immediate “ measures be taken to carry out the recommendations, in all particulars, “ contained in the report.” Further report on this subject was made in connection with the recent enteric fever in Bicester by Mr. Dyson Wood, on January 6th of the present year, to the following effect :—“ Having regard “ to recent unfavourable analyses of drinking water which have come under “ my notice, and to the knowledge which I possess of the unsafe position of “ numerous other well waters in the town, I am quite of opinion that it is “ necessary for the future safety of Bicester that your Council should, with “ as little delay as possible, take up practically the question of supplying “ the town with a wholesome water supply from an outside source.” It may here be noted that the Urban District Council had already, on November 11th, 1895, resolved that, “ An engineer be engaged to make a “ survey, and estimate cost of waterworks for the town in view of the “ possibility of the same being found necessary for the future.” The water supply of the town was again under discussion at the Council’s meeting on January 6th, 1896. When I visited Bicester, in March and April of the present year, this subject had not yet passed the stage of discussions and resolutions ; the fever meanwhile continuing to occur in the district. Before leaving Bicester, I met and conferred with the Chairman of the Urban District Council on April 10th, and at that conference I laid especial stress on the need for immediate steps being taken by the Council to provide a sufficient supply of pure water for the inhabitants of Bicester. The Chairman undertook to bring the matter under the notice of the Council at their next meeting.

As I have indicated, the most pressing need of Bicester is a pure water supply. The District Council, however, should also give attention to measures remedial of other unhealthy conditions described in this report. Defects as regards structure, ventilation, and flushing of sewers, as well as defective conditions of house and yard drainage should be sought out and remedied when discovered. The methods of disposal of excreta in Bicester leave much to be desired, and improvement of these should have the attention of the Council. Much house property in the town is old and dilapidated, and measures should be taken to secure the closure or sufficient improvement of such dwellings. The need for a sufficiency of open space around inhabited houses and for suitable paving of yards attached to them should also receive attention.

I have to thank Mr. Tanner, Clerk to the Urban District Council ; Mr. Dyson Wood, Medical Officer of Health ; and Mr. Branford, Acting Inspector of Nuisances, for assistance afforded to me in connection with the inquiry which forms the subject of this report.

THEODORE THOMSON.

May 8th, 1896.